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A spatial analysis of seasonal variation in dissolved nutrients and greenhouse gasses along two river networks draining watersheds of contrasting land use

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Widespread human activity such as agriculture and urban land use has increased the availability of dissolved reactive nutrients in river networks. As such, the biogeochemical processing of these nutrients in streams and rivers may make them significant sources of carbon dioxide (CO_2), methane (CH4), and nitrous oxide (N2O) gasses which are responsible for the majority of heat trapping capacity in the modern atmosphere. We replicated a synoptic sampling regime across seasons to measure dissolved inorganic nutrients and gasses at 80 stream/river sites in two contrasting U.S. watersheds, the Manistee River Basin (MI) which is ∼83% forested and the Tippecanoe River Basin (IN) is 82% agricultural land use. We used Spatial Stream Network (SSN) geostatistical modeling to differentiate the spatial heterogeneity of dissolved nutrients and greenhouse gasses among seasons and between watersheds of contrasting land use. We modeled the spatial distribution of dissolved nutrients in each basin to separate the effects of catchment and in-stream processes compounded with fine-scale versus broad-scale gradients of stream water chemistry. Preliminary results suggest that dissolved nutrient and gas concentrations in both river networks during winter and spring were strongly influenced by land use type, exhibiting an "accumulating" broad-scale gradient. In contrast, during the primary growing season of summer and early autumn we found that networks displayed an array of "hotspots" or small-scale spatial dependence. As the world's land area undergoes continued development, high-resolution datasets will be critical in understanding the seasonal heterogeneity of spatial patterns along river networks and will allow us to predict the future impact of land use in a changing climate.